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Exam area: Social Network Analysis
Start time: 10:00AM 10/20/2011
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Question options (Selected question in **bold)**:

- What are the cooperation problems targeted by local sustainability partnerships? What are the various roles of individual decision-making, social networks, and institutions in solving those problems? Use examples from your research project on sustainable viticulture.
- **What is social network analysis? Explain some of the basic methodological concepts, along with some of the different measures and analyses that will help understand behavior in the context of local agricultural decision-making. Use examples from your research project on sustainable viticulture.**
- What are some key theoretical frameworks that are used to understand the structure of social networks, that is, why links form among actors? How do these theoretical frameworks fit with theoretical concepts and frameworks in geography? Use examples from your research project on sustainable viticulture.

What is Social Network Analysis? Social network analysis (SNA) is a research paradigm consisting of concepts, methods, and theories designed to empirically study human behavior as a consequence of network structure (Knoke and Yang 2008; Scott 1991; Wasserman and Faust 1994). Social scientists are generally interested in understanding human behavior, but traditional approaches that focus only on attributes of individuals ignore, at least theoretically and methodologically, the reality that humans are social animals. Our actions, beliefs, attitudes, and other individual level attributes are informed through social interaction with others humans. In the rest of this essay I will discuss some of SNA's basic concepts and methodologies by way of their application in knowledge management outreach and education programs in CA viticulture.

First, what is meant by "social network" must be specified. In SNA a social network is a specified set of nodes representing a classes of actors such as individuals, teams, agencies, or nations of which at least two are connected by a specified set of ties representing a class of relations such as resource transaction, affiliation, kinship, authority, economic exchange, or technological diffusion. Ties can be directed or non-directed, and dichotomous or valued. A network can be represented as a matrix (Figure 1) or as a sociogram (Figure 2). Attribute data is stored in a separate file (Figure 3).

To understand how SNA works, and especially to understand its advantages and limitations, I find it useful to review the underlying assumptions as outlined by Knoke and Yang (2008: 4). First, in explaining human behavior, social network structure is

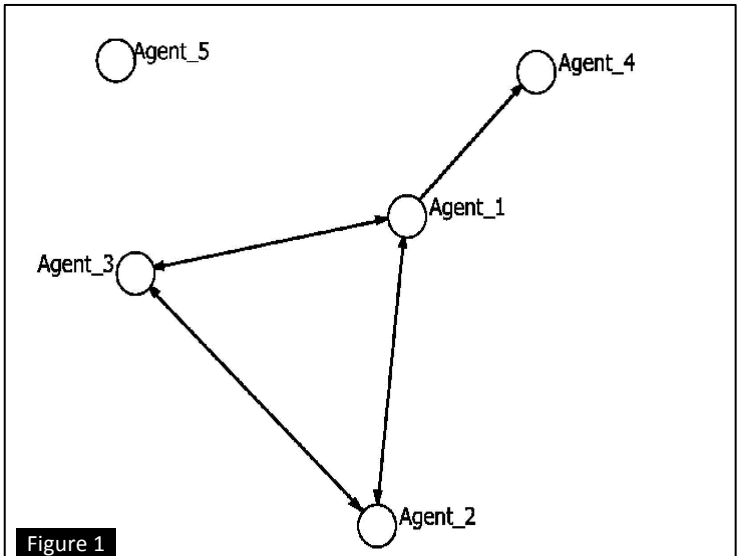


Figure 1

Figure 2	Agent_1	Agent_2	Agent_3	Agent_4	Agent_5
Agent_1		1	1	1	0
Agent_2	1		1	0	0
Agent_3	1	1		0	0
Agent_4	0	0	0		0
Agent_5	0	0	0	0	

Figure 3	Age	Grower	Outreach
Agent_1	32	0	1
Agent_2	44	1	0
Agent_3	40	1	0
Agent_4	67	1	0
Agent_5	56	1	0

often, but not always, more important than actor characteristics. Second, human behavior is influenced by position in the social network. Third, social networks are dynamic.

The relevance of SNA to viticulture. Before proceeding I want to make the case that SNA is a relevant research approach for the subject of viticultural management. While there is heretofore no research on knowledge networks in California viticulture *per se*, there is sufficient evidence to suggest that interpersonal relationships of knowledge exchange, or "knowledge relationships", between growers and outreach professionals are prevalent. Vineyard management, and grower adoption of viticultural practices is very much a human behavior, and it is reasonable to hypothesize that the knowledge relationships growers engage in have influence over this behavior.

Several studies suggest that knowledge relationships are among growers' most important resources of viticultural information. Brodt and Thrupp (2009) found that from a sample of growers participating in the California Sustainable Winegrowing Alliance's sustainability certification program, 30% reported Pest Control Advisers (PCA) and 25% reported UC farm advisers as their most important source of information about a range of viticultural practices. Data from my dissertation research on Lodi winegrape growers and from two previous Lodi grower surveys (Dlott and Dlott 2005) suggests that growers also rank knowledge relationships highly. Figure 4 presents a year-to-year comparison of grower ranking of information resources by usefulness. I have highlighted in orange those information sources that qualify as knowledge relationships. From a visual observation it is clear that Lodi growers rank knowledge relationships relatively high compared to other information resources.

Figure 4	1998	2003	2011
Highest ranked	PCAs	UC Farm Advisors	PCAs
.	Farm Advisors	PCAs	Other winegrape growers (not family)
.	IPM Grape Pest Manual	LWWC IPM Staff	Winery personnel
.	LWWC IPM staff / LWWC meetings/seminars	UC IPM Grape Pest Manual	Field crew
.	LWWC IPM Update	Field Days / Research/IPM Newsletter	UC Farm Adviser
.	Other grape growers	Breakfast meeting	University publications
.	University publications	Lodi Winegrowers Workbook	Trade journals
.	Your field crew	Winery personnel	Viticulture textbooks and reference books
.	Winery personnel	University publication	Internet resources
.	LWWC resource library	Other grape growers (not family)	LWWC sustainability workbook
.	Lodi New Sentinel weather page / Trade journals	Other winegrape growers (family)	Newspapers
.	Computer information services	Trade Journals	Viticulture consultant
.		UC website	CSWA sustainability workbook
.		LWWC resource library	
Lowest ranked			

Using social network analysis in viticultural knowledge management. Given the prominence of knowledge relationships as information resources in California viticulture, I argue that there is much potential in designing outreach and education programs that take a social learning approach. However, it has been argued that the popular models of knowledge management, in particular Communities of Practice (Wenger 1998; Wenger, McDermott, and Snyder 2002), "suffer from a lack of rigorous empirical research" (Borgatti and Foster 2003: 997). What SNA brings to the table is a means to empirically evaluate the knowledge network with the aim of identifying leverage points suitable for optimizing social learning through network restructuring. "SNA provides an x-ray of the inner workings of these groups that helps community leaders locate the high-leverage intervention opportunities" (Cross, Laseter, Parker, and Velasquez 2006: 33-34).

The Halliburton example. Cross, Laster, Parker, and Valasquez (2006) demonstrated the potential of SNA as a diagnostic tool for managing a knowledge networks. Their insights were gleaned from work they did for the company Halliburton. Halliburton needed to improve the efficiency and effectiveness of their higher management employees. Cross and his colleagues used SNA to identify leverage points. Interventions on these leverage points led to positive and measurable changes in customer satisfaction, production quality, revenue, and productivity. These improvements were achieved by restructuring the knowledge network such that employees were able to access the information they

needed quicker and easier. They identified four leverage points: over-connected people, disjointed information silos, gaps in awareness of expertise, and peripheral network members (Cross, Laseter, Parker, and Velasquez 2006: 35).

Over-connected employees were those overburdened by requests for information. Halliburton had technical advisers whose official job description was to offer problem-solving advice in a given area of specialization. Using SNA they discovered that the demand on technical advisers was too great. They were bogged down with repetitive and mundane requests. This created knowledge bottlenecks.

Second, SNA identified knowledge silos. Knowledge silos were sub-groups that had cooperatively developed useful techniques for dealing with problems common to Halliburton employees but these groups were disconnected from the rest of the network due to a lack of ties reaching outside of their sub-group. The sub-groups 'good ideas were not being shared.

Third, Halliburton employees were not very good at knowing who had what expertise. When confronted with a problem, their first action was to contact the technical adviser. This led to the overload discussed previously. Moreover, the technical advisers themselves were not very good at knowing who within the broader Halliburton community had what experience. This limited advisers' ability to make referrals. It also means that employees did not know which other employees to contact directly for advice about their specific question.

Finally, their analysis identified highly knowledgeable and experienced employees who were on the periphery of the network and were therefore not well, or at all, connected with other employees. Their human capital was not being shared put to use at the system level.

Halliburton made two structural changes in the knowledge network. First, the company created two new jobs: "knowledge brokers" and "local knowledge champions." The job of knowledge brokers was to connect employees who needed answers to employees who had answers. It was their job to know who knew what and act as a broker of useful knowledge. Knowledge brokers worked across Halliburton's global network. Local knowledge champions worked more locally. They communicated with the knowledge broker to extend his or her network reach to local employees. It was the knowledge champion's job to have "boots on the ground" and know who needed help. Second, certain "high-potential" employees were identified and temporarily or permanently transferred to other posts within Halliburton. The intended result was for these employees to build new knowledge relationships between their previous and new local communities and to diversify the pool of knowledge and experience. These structural changes were all geared toward increasing the ability of the knowledge network at serving the knowledge needs of employees. Apparently the project was successful, and a follow-up survey showed that employees reported reduced time and energy required to access the information they needed to do their jobs well.

Identification of over-connected people, disjointed information silos, gaps in awareness of expertise, and peripheral network members can be accomplished by basic SNA measures. Centrality measures (Wasserman and Faust 1994: 172) can be used to identify over-connected individuals. Methods for detecting cohesive subgroups (Wasserman and Faust 1994 249) can be used identify silos and finding structural holes (Burt 1992) can indicate whether silos are disconnected from the rest of the network. The research thread within social network analysis of social cognition (Borgatti and Foster 2003) dedicates its focuses on the degree to which network actors are aware of what resources others in the network have. Identifying peripheral actors can be accomplished through core/periphery detection procedures (Borgatti and Everett 1999). Finally, an extensive body of research and theory supports the hypothesis of the knowledge brokerage (Burt 1992; Burt 1997; Burt 2004).

The Halliburton example demonstrates how SNA can be used to inform strategic management of a knowledge network with the ultimate goal of improving the network's ability to meet the knowledge needs of practitioners. It is not a stretch to imagine how agricultural outreach and education institutions can apply this approach.

In a preliminary analysis of the Lodi knowledge network (Hoffman, Lubell, and Hillis 2011) I found the UC county farm adviser, like Halliburton's technical advisers, to be over-burdened with the task of knowledge brokerage. There is both quantitative and qualitative evidence. Across two measures of centrality, eigen vector (Newman 2006) and degree (Wasserman and Faust 1994: 172), I found that the farm adviser is by far the most central actor. Figure 5 shows average centrality scores by different outreach categories. This suggests that the farm adviser is positioned to have a good awareness of growers information needs and has the ability to rapidly spread information through the entire social network. These are favorable abilities, but in an interview with the farm adviser it was apparent that he struggled around the obstacle limited personnel and time resources. Following the lead of Halliburton, one solution to this bottleneck would be to recruit well-positioned individuals in the knowledge network to assist the farm adviser. I also found that growers who are also outreach professionals are the best connected in the network. These individuals score higher across both centrality scores than do actors who are only growers and actors who are only outreach professionals. Perhaps the farm adviser could increase the effectiveness of the knowledge system by allying and partnering with individuals who are both growers and outreach professionals. This is one of many examples of how SNA can be used to identify leverage points in the knowledge network.

Figure 5

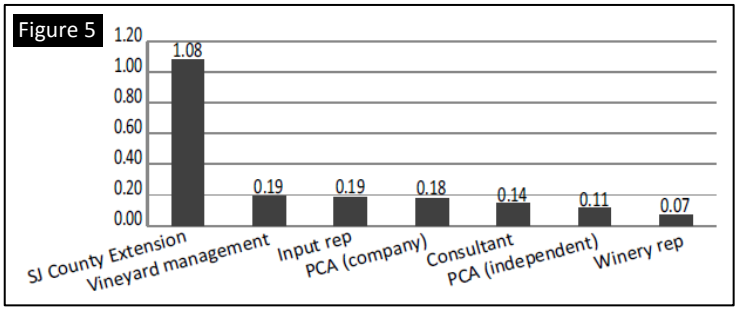
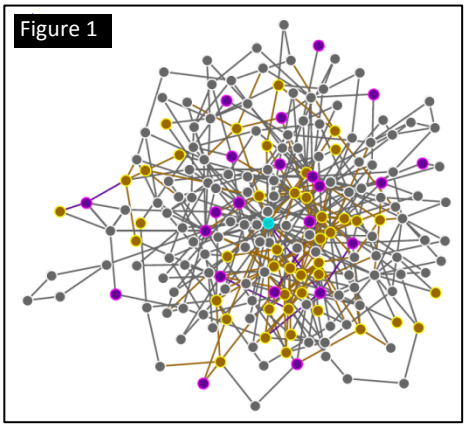


Figure 6 visually represents Lodi's knowledge network. The County Farm Adviser (aqua) is very central. Individuals who are both growers and outreach professionals (orange)

strongly tend toward the center so we see a higher density of these individuals in the middle of the network. Those who are exclusively outreach professionals (purple) also tend inward but to a noticeably lesser degree. In contrast, individuals who are exclusively growers (grey) are concentrated just outside the networks center and also make up the majority of the peripheral individuals.



Concluding remarks. Given that knowledge relationships, and by extension knowledge networks, are such an important information resource for winegrape growers, there seems to be much potential in designing outreach and education programs to use knowledge networks to support social learning around sustainable agriculture. While social leaning has already been identified as critical in extending sustainable agriculture (Hassanein 1999; Pretty 1995; Pretty and Chambers 2003; Warner 2007), the next frontier might be to explicitly draw on network theory to design new and improve existing outreach and education programs and to draw on network analysis to evaluate programs on their ability to optimize social learning and influence adoption of sustainability-oriented best management practices.

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